solplan review

the independent newsletter of energy efficient building practice

the drawing-room graphic services ltd.
box 86627 north vancouver b.c. V7L 4L2

No. 24 December-January 1989

INSIDE . . .

Mechanical ventilation is now required in many jurisdictions for health and safety of the occupants and sound building science concerns. But does the equipment available do the job we expect?

A just completed study suggests that there are many problems with most installations. The investigators looked at practices in Europe as well as Canada. The results are disturbing - but now that we have evidence, we can begin applying proper design techniques, use equipment that works, and look for the mistakes that make current installation practices useless.

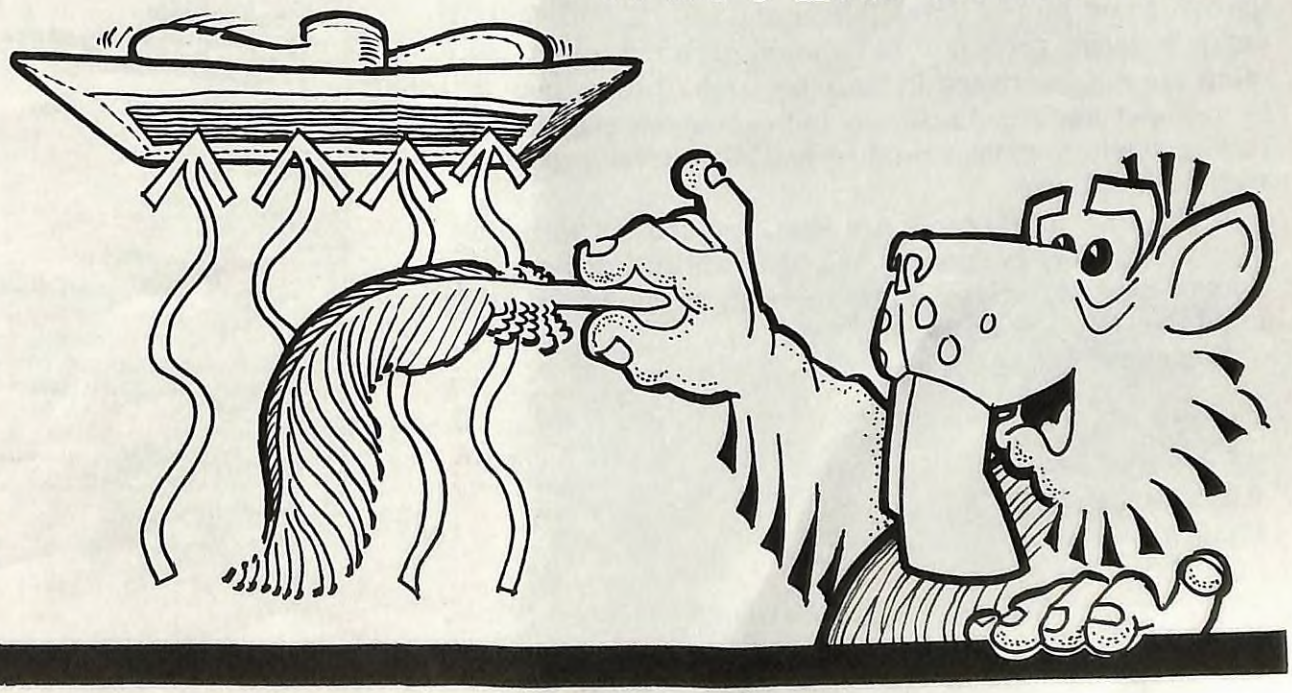
The B.C. Building Code has been amended to make the ventilation requirements more clear and understandable by the builder. Some significant modifications have been made to the requirements that we think are of interest to all our readers. The changes point to the direction that ventilation standards are going. We review the key points of the revised code.

Fireplaces are a major source of energy loss. Many of us think that dampers will actually close the flue and reduce air movement through the flue when the fire is not lit. Recent (disturbing) measurements have shown this is not the case. We present a summary of the findings.

Other items include letters from readers, a review of a presentation on making how to develop and maintain a corporate image, to keep your bottom line healthy, a review of energy efficient lamps now on the market, and much more.

CONTENTS

FAN PERFORMANCE



FROM THE PUBLISHER

Recently we were introduced to a couple of earnest, well meaning engineers who had come up with what they thought was an ingenious new device: a heat recovery device for furnace flues. The objective was to recover some of the heat lost up the flue and use it to preheat incoming ventilation air. The idea was triggered by the concern for tempering of ventilation air that is now required by local code. Sounds good?

Evidently, someone in a position to hand out money thought so too, as funding to test a prototype (they would not admit which one) was made available to them.

They stressed the objective for the device was to preheat ventilation air. In a brief discussion following a presentation of their concept, it became evident that while they were technically knowledgeable in some building matters, they did not have any appreciation of the ventilation issues they were getting involved with. As a preheat for ventilation air the concept was flawed because it did not deal with the dynamics of flue gasses nor the supply of ventilation air during times the flue is not hot.

It is not my intention to rehash the specifics of their product idea. Rather, the concern is with the kind of evaluation (or lack of it) that was done to the funding application.

How many people are there in a position to hand out money for research, product development or testing, and who do not know the technical issues they are dealing with?

We have long been of the opinion that government funding is not only appropriate, but necessary. Many bright ideas for new products or technologies are developed by independent inventors or entrepreneurs who in most cases lack the resources to do proper development and testing work. Unfortunately, major corporations (who do have the resources) too often are not interested in basic research. Rather, they will step in to undertake the marketing and commercialization of the new technology when a product has been developed and is technically proven.

It is a shame that funds are being handed out without a proper technical evaluation. We have world class building science experts in this country that can be consulted. I only hope that this was an isolated incident.

Somehow, I doubt it is.

Richard Kadulski
Publisher

solplan review
the independent newsletter of energy efficient building practice

Editor-Publisher: Richard Kadulski
Illustrations: Terry Lyster

SOLPLAN REVIEW is published 6 times per year by:
The Drawing-Room Graphic Services Ltd.
Box 86627, North Vancouver, B.C. V7L 4L2
Tel: 604-689-1841 FAX: 604-689-1401

Street address:
205-1930 West Broadway
Vancouver, B.C. V6J 1Z2

ISSN: 0828-6574

SUBSCRIPTIONS: $30.00 per year.
U.S.A. and other foreign subscriptions payable in U.S. funds or $36.00 Canadian.

CHANGE OF ADDRESS: Please include a mailing label or copy all information off label for faster, accurate processing.

Unsolicited contributions and manuscripts welcome. Include self-addressed prestamped mailer if return requested. Publisher not responsible for loss or damage of same. While every effort is made to provide accurate and complete information, we do not warrant or guarantee the accuracy and completeness of such information.

ADVERTISING POLICY: Publisher's discretion in the acceptance of any advertisement. No endorsement is stated or implied by the publisher.

Printed in Canada
Second Class Mail Registration No. 6855
Postage paid in Vancouver, B.C.

Date of Issue: January 1989

SOLPLAN is a registered trademark of The Drawing-Room Graphic Services Ltd.

FAN PERFORMANCE
Do Fans Really Work Like They're Supposed To?

Richard Kadulski

A major study to review the performance of residential fans has just been completed. The object was to discover how exhaust fan systems are being installed in Canadian houses, and how these could be improved.

An international search was done to determine ventilation practices in other countries. The search looked at technical data such as flow characteristics required for proper system design. Field testing in four Canadian cities established current system installation procedures and the real exhaust flow rates (as compared to theoretical rates).

It was found that European and Japanese ventilation systems differ from practices in North America. Central systems are prevalent in Europe while Japanese fans tend to be through-the-wall. For systems comparable to those used in North America there was no apparent advantage to the off-shore products.

Performance ratings based on different standards made meaningful comparison difficult. One Japanese fan tested to North American standards showed airflow rates much below manufacturer's ratings.

Proceedings from conferences in a number of European countries contained many papers which not only described current ventilation system practice but also occupant acceptance. Findings are summarized in Table A.

A central exhaust system, with some variations in approach and components from one country to another, is the dominant practice in Europe.

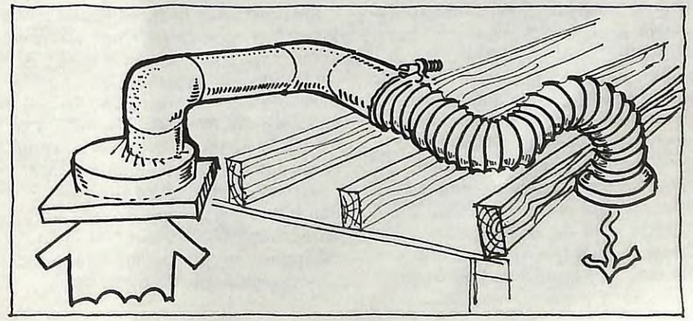
In all papers the authors reported that continuous exhaust, by either mechanical or passive means (i.e. driven by temperature or pressure differences) was the rule, quite distinct from the more common practice in Canada of user-controlled (often infrequent) operation.

Mechanical exhaust systems with attic mounted fans and make-up air inlets (in most countries located in the upper window frame or above the window) are the most common. The exhaust airflow is generally regulated by controlling the speed of an attic mounted fan/motor. Some form of provision is made for the occupant to regulate the amount of make-up air entering each room (e.g. adjustable slotted grilles or a simple slide to adjust opening area).

While it is generally recognized that residential exhaust systems in Canada are under-utilized by homeowners because they are noisy, perform poorly and are perceived as ineffective, occupant acceptance of exhaust systems in Europe also seems to be relatively low.

Range hood fans currently are being installed in only about 50% of U.S. homes, and are used frequently in less than half of these. The major deterrent to range hood use is noise.

The most common complaint reported is cold drafts due to poor design and/or location of make-up air inlets. The second most common complaint is that the occupant is not able to turn off the exhaust fan.



The amount of make-up air and the fan speed are the only variables controlled by the homeowner. Two investigators reported that many residents defeated the object of the central system by either disabling the fans or blocking the makeup air inlets to reduce noise or cold drafts (new code requirements in Finland call for a portion of ventilation to be handled by a fan operating continuously, with no occupant access!).

Occupant acceptance of exhaust ventilation systems in Europe seems to be as low as that generally admitted by homeowners in Canada. The difference in the climates between Europe and most of Canada was seen as the main reason for concluding that central exhaust systems, as designed and installed in Europe, would not be accepted in Canada.

Field observations and testing of residential exhaust systems in Vancouver, Calgary, Quebec City and Halifax were done to determine what equipment is used and how it is installed. This was followed by spot measurements of airflow capability and sound levels for both bathroom and Kitchen range hoods.

The study was made not just to identify what fans and components are being used but also to determine how they are being installed.

Little or no technology is applied to the design of the 'systems' to ensure that an adequate quantity of air is

TABLE A: European Ventilation Practice

(Temperatures are winter design temperature for the capital city of the country)

COUNTRY	EXHAUST SYSTEM TYPE	SYSTEM DESCRIPTION	OCCUPANT ACCEPTANCE
Denmark (-7°)	Central Mechanical	* Continuous exhaust from kitchen, toilet & bath; make-up air through open windows, inlet valves, leakage. * Recent regulation allows 40% of rated volume flow 12 hours each day.	* N/A
France (-4°C)	Central Mechanical	* Continuous exhaust from kitchen, toilet & bath; make-up air through slot near ceiling or upper part of window frame * Minimum continuous ventilation 90 m^3/hr (53 cfm). * Speed control only. * Air inlets, exhaust valves and fan sized to produce negative pressure ~10 Pa below atmospheric pressure. * Doors undercut to allow free movement of ventilation air throughout house.	* Inlets often blocked by residents due to cold drafts, soiling on walls or to reduce noise from outside. * Designed to run continuous, but 25% of homes surveyed had fans disabled (fuses removed). * 49% considered system noisy * Occupants wanted more control over system operation.
Germany (-9°C)	Central Mechanical	* Continuous exhaust from kitchen, toilet & bath; make-up air inlets at low level away from occupant spaces. Some exhaust only. * Large cross-sectional area inlet to keep velocity low. * Exhaust-only not allowed where combustion appliance used/radon problem.	* N/A
Netherlands (-5°C)	Central Mechanical	* Continuous exhaust from kitchen, toilet & bath; make-up 'ventilation grids'installed above windows or a 'fanlight' (small openable window above main window) * Dutch standard calls for 25m^3/hr (15 cfm) per person	* Complaints of drafts due to airflow through ventilation grids.
Norway (-11°C)	Central Mechanical	* Continuous exhaust from kitchen, toilet & bath; adjustable vents on outlets; make-up air through vents in upper frames of windows. * Speed control only.	* Control defeated by occupant in many cases. * Condensation not a problem.
	'Passive' Central	* Vertical outlet ducts from kitchen & bathroom; inlet vents in windows * Driven by temperature and pressure difference	* Inadequate in 'tight' construction leading to occupants opening windows. * Condensation problems.
United Kingdom (-3°C)	'Passive' Central	* Vertical outlet ducts from kitchen & bathroom; simple rain cover on roof; ducts of duct cross-insulated in attic space; make-up air through inlets; total inlet area 1/3 sectional area.	* Some complaints of draft near windows in cold weather. * Wind noise at roof cover during windy weather. * Occupants said steam and smells from cooking cleared quickly.
	'Trickle Passive' Central	* Trim' vents installed in windows without vertical duct. * 350 mm^2 open area/window when fully open. * Vents in window provide both 'exhaust' and 'make-up'.	* In retrofit cases marked reduction in condensation and mould growth.

removed from the house. The most commonly used exhaust fans and range hoods are cheap low quality units.

The field survey showed that at the moment many trades are involved in the installation of ventilation equipment, including electricians, sheet metal workers, roofers and siders.

Very few of the 20 installations inspected showed any evidence of system design or post installation testing. Use of flexible ducting in bathroom fans was widespread. Downsizing of the ducting from manufacturer's specifications was common. The bathroom fans were measured at an average of 44% of their rated flow; kitchen fans were measured at 38% of rated flow.

Measurements of room sound levels during fan operation did not correlate to rated fan sound levels. Variability of fan installation, room size and reverberation characteristics, as well as measurement uncertainties, appear to have masked the differences in sound levels due to the fans themselves.

The study highlighted the flow deficiencies, and made strong recommendations to use certified equipment installed to manufacturer's specifications. Disregarding these instructions may result in systems that do not meet design flow rates, leading to inadequate residential ventilation.

The practice of supplying make-up air to individual rooms directly from the outside is unlikely to be acceptable in colder climates such as Canada's. Complaints of cold drafts, the most frequent problem reported in the study, are bound to be a greater problem in Canada.

Installation standards should address the issues of taping of duct joints, insulation of ducts, use of flexible ducts, and types and location of duct terminations.

Exhaust flows for bathroom fans and kitchen range hoods, as installed in Canadian homes, are much lower than the nominal airflows described by manufacturers in their published information.

The size of the ducts connected to the exhaust fans and range hoods are consistently below that specified by the manufacturers.

Study Conclusions

There is enough data available on typical components and fans to design effective residential exhaust systems. However, poor installation practice is largely responsible for homeowner dissatisfaction with local exhaust systems.

Builder guidelines should emphasize above all else that the manufacturer's installation instructions must be followed. This simple point alone will assure that most residential exhaust systems work as intended. For those systems requiring more ductwork there may be a need to emphasize the importance of using a bathroom or range hood equipped with a centrifugal rather than a propeller fan. These are less sensitive to external pressure and thus have a broader operating range.

Inspection authorities should be made aware of the importance of ensuring that exhaust systems are properly sized and installed. While inspectors generally check to see that exhaust fans are installed as required by local codes, they do not normally check whether the fan has any airflow or whether the ductwork is in accordance with manufacturer's instructions. The report suggests that responsibility for a properly installed exhaust fan should not rest entirely with the builder.

Flexible ducts must be installed carefully, perhaps limited to very short runs or if they must be used, should be of a larger diameter duct. For example, 125 mm flexible vinyl duct where 100 mm galvanized round duct is adequate. (The B.C. Building Code now calls for increasing duct size in this type of situation).

The plastic dryer vent type wall cap

BATHROOM FANS

As typically installed, deliver only about 45% of their advertised airflow. The most commonly used fan is rated by the manufacturer at 25 l/s (50 cfm) at 25 Pascals. The average measured flow as installed was 12 l/s (24 cfm). The same fan has been flow tested in the ORF labs and found to deliver only 15 l/s (60% of the rated flow at 25 Pascals). The poor performance may simply be a case of a bathroom fan with an optimistic rating delivering its actual capacity rather than poor installation.

RANGE HOODS

Airflows were found to deliver only 34% of the manufacturer's rated airflow. Nine of the fourteen range hoods tested in the field were representative of units tested at ORF and had delivered 80 to 100% of the manufacturer's claimed airflow. The poor performance of the range hoods was thus largely due to excessive pressures created by poor duct design.

Table B: Airflow and Sound Test Results

BATHROOM FANS

CITY	Rated Airflow l/s (@25Pa)	Measured Airflow l/s	% of Rated Airflow	Rated Sound Level (Sones)	Measured Sound level (dBA)	Sound Level Fan off (dBA)
Vancouver	24	10.6	44%	3.0	66.3	40.3
Calgary	24	12.8	53.5%	3.0	49.5	42
Quebec	24	8	33.3%	3.0	54.5	22.7
Halifax	24	10	41.6%	3.0	52.6	33.6

Airflow and Sound ratings were derived from manufacturer's published information

appears to be as acceptable, for a bathroom fan application, as the manufacturer supplied metal wall cap. However, for range hood applications the wall cap supplied by the fan manufacturer should be used, together with the 85 mm x 255 mm duct normally specified.

Taping of joints in galvanized round duct reduced air leakage, (25% leakage without tape compared to 6% with tape). However, in the typical range hood installation taping the duct joints did not make a difference. The most significant leakage is probably at the adjustable elbows, each of which have 5 circumferential joints as well as 2 transverse joints. The bathroom system tested had two elbows, while the range hood system had only one.

Equipment

Industry statistics on kitchen and bathroom fan sales don't exist. Manufacturers expressed an interest in a statistics program, but refused to provide any information!

There are 6 major manufacturers and suppliers (although their equipment may be sold under a variety of name plates).

The study did not identify the equipment tested by name.

This item is based on fidinngs if a study "Residential Exhaust Equipment" which was prepared for Canada Mortgage and Housing Corporation (CMHC). The work was done by the Ontario Research Foundation and the Technical Services Division of HRAI.

LETTERS TO THE EDITOR

Sir,

Jim Marke's article (Low-E vs Triple Glazing, Solplan Review No. 22) expresses opinions about some of the differences between Low-E coated double glazing and non coated triple glazing.

While we can agree with some of what he says, he has, unfortunately, left an impression with some of your readers who have contacted us (and probably more who have not contacted us) that there is a contest between the two products and that triple is better.

AFG Glass Inc. manufactures basic float glass and further processes it by applying a high performance Low-E coating and assembling factory sealed insulating glass. We have been producing Low-E for nearly seven years and manufacturing insulating units for forty years.

The truth of the matter is that Low-E coated double glazing offers an improvement over non-coated double glazing. While the "R" value of the Low-E unit is the same as a triple (assuming both the Low-E double and Triple have 13mm (½") airspaces and that the Low-E coating is the higher performing "sputter" type) there are, despite having a lower shading coefficient, some quite distinct advantages in a Low-E unit. Being a thinner and lighter, the unit offers significant advantages for both window manufacturers and the end user.

However, as far as we are concerned, there is no contest between the two products. We will quite happily sell three pieces of glass if that is what is preferred. We do, in fact, manufacture triple units and are even doing so with Low-E coatings as well. We also expect to be supplying the same units with argon in place of air in the very near future. It's very much a case of using the product which best meets the needs of the application and the potential for Low-E coated glass in this respect is enormous.

Howard Griffiths,
Manager, Sales and Marketing
AFG GLASS INC.
Concord, Ontario

Sir,

Re: "Radon: An update" (Solplan Review, Oct-Nov 1988)

The "increased profile" of radon has created the same "Fast Buck Charlatans" in Saskatchewan as you describe have appeared in Vancouver. I therefore congratulate you on your coverage of the Radon problem and trust that it will continue.

What constitutes a safe level of Radon in a home is probably the most contentious issue. Until all parties are "singing out of the same hymn book" the general population will find it extremely difficult to understand.

Through the R-2000 Program, Radon testing has been taking place for a number of years. Originally the "Terradex Corp." device was used, but it was determined not to be accurate enough. They recently have been using the "Rad Surveymeter", with excellent results.

The "Rad Surveymeter" is not listed in your article, perhaps because it tests for Radon daughters.

I wanted to point out the existence of an alternate method of determining Radon concentrations in the home. The Rad device can be obtained from:

R.A.D. Service and Instruments Ltd.
c/o Dr. H.L. Pai
Unit 208, 50 Silver Star Boul.
Scarborough, Ontario M1V 2W4
Tel: 416/298-9220

I believe Rad Service & Instruments Ltd. has been purchased by Honeywell International. This lends credence to their quality of testing (at least in my mind).

I look forward to future issues of Solplan Review and wish you continued success.

R. Doug Mitchell
Technical Officer, EMR
Saskatoon, Sask.

VENTILATION REQUIREMENTS: Changes to B.C. Building Code Ventilation Standards

Richard Kadulski

The ventilation requirements of the B.C. Building Code have been revised, and are now in force. The revisions go a long way to cleaning up the code language, making it more understandable.

A number of tables are provided with the code, to ease calculation. For most standard houses the builder need just follow the steps through a series of tables to calculate what's required.

We're presenting the essential elements of the revised code.

System Capacity

All dwelling units must have a mechanical ventilation system capable of providing at least 0.5 air change per hour (ACH) during the heating season.

Systems designed to distribute ventilation air to or from all rooms, (but excluding rooms such as storage, foyer, laundry or mechanical) must be capable of providing at least 0.3 ACH.

The ventilation rate is to be based on the total heated volume (including basement and heated crawl spaces).

A portion of the required ventilation must be controlled automatically by a centrally located dehumidistat or be provided by a continuously operating fan during the heating season. Table 9.33.3.B spells out the minimum required rates to be controlled automatically or continuously.

In many houses this will mean that bath fans must be run continuously or controlled on a dehumidistat.

Most houses (over 2100 sf) will require that 80 cfm of capacity be controlled by a dehumidistat. Houses with continuous ventilation (e.g. HRV or continuous exhaust fan) will require 40 cfm continuous (80 cfm for houses over 4300 sf).

The alert reader will note that the minimum ventilation rate provided continuously (at 80 cfm for large houses) can be as low as 0.15 ACH. While the system *capacity* must be .3 ACH for distributed and .5 ACH for non-distributed ventilation, it need not run at that rate continuously.

The ventilation standard related to air changes per hour is not a meaningful measure. We began using it when we first seriously looked at ventilation requirements in homes, and had to look at what others do. In Europe, where ventilation has been mandated for much longer, they may use "air changes per hour" - but the volume of the average dwelling unit is much smaller than the average Canadian home.

What has been recognized by the B.C. Building Code (directly or otherwise) is that ventilation is for people. The acknowledged minimum quantity required by a human is around 15 cfm (plus or minus 5 cfm).

Exhaust equipment such as central vacuums, downdraft cook tops and clothes dryers will not be considered in calculating the ventilation system capacity.

Make-up Air

Mechanical ventilation systems must include provision for introduction of fresh make-up air from the exterior to match the ventilation controlled automatically.

Make-up air is not needed if the dwelling has no naturally-aspirating fuel-fired heating appliances, or if all fuel-fired appliances (including fireplaces) are isolated from the interior atmosphere.

In colder climates (design temperature less than -10°C) tempering of the make-up air is required. It can be done by mixing it with forced air heat, by use of an HRV, fan coil unit or other suitable method.

Make-up air need not be tempered in mild climate zones (winter design temperature above -10°C). It can be supplied into areas such as utility or storage rooms.

Make-up air tempered through forced-air heating systems must be provided by a duct connected directly into the return air plenum. The make up air duct must be provided with a motorized damper that is interlocked with the exhaust fan controlled by a dehumidistat so that the exhaust fan only operates when the damper is open. The dehumidistat must also be interlocked with the furnace fan so that the furnace fan will operate when the exhaust fan is on and the damper is open.

Table 9.33.3.B.
Forming Part of 9.33.3.5.

MINIMUM REQUIRED VENTILATION RATE CONTROLLED AUTOMATICALLY OR PROVIDED CONTINUOUSLY			
Max. Total Interior Volume[1], m^3	Max. Total Floor Area[1] Based On Standard 2.44 m Ceiling Height, m^2	Minimum Ventilation Rate, Controlled Automatically, L/s	Minimum Ventilation Rate, Provided Continuously, L/s
244	100	20	10
366	150	30	15
488	200	40	20
732	300	40	30
975 and over	400 and over	40	40
Column 1	2	3	4

1 l/s = 2 cfm

Additional make-up air must be provided for other exhaust appliances installed in the dwelling unit with a rated capacity exceeding 0.5 ACH. This may have to be by a fan-forced unit of equivalent capacity interlocked with the exhaust appliance. This would apply to equipment such as high capacity downdraft cook tops.

Small houses with naturally aspirating appliances require fan forced make-up for 100% of the capacity (tempered if in a cold climate with winter desig temperatures <-10°C).

A naturally-aspirating forced heating system serving a maximum total heated floor area of 460 m^2 is acceptable as providing the ventilation requirements, if the system is capable of providing at least 0.3 air changes per hour during its heating operation or has an air supply (as provided for in a table providing minimum supply duct diameter).

Combination Forced Air-Ventilation

In houses up to 4900 sf, with a naturally drafted furnace, if the supply air is directly connected to the return air plenum, no other ventilation is required if the system can contribute .3 ACH. This type of system requires dehumidistat control of the furnace fan or a continuous running furnace fan.

This system is a minor modification of existing furnace installations that have proven to be acceptable in the general housing stock. It is being accepted for the time being because of its proven track record (and in part because of pressure from the gas industry).

As houses get tighter and more sealed combustion furnaces are used it is likely that this kind of passive system may not be adequate.

Combustion air ducts for fuel burning appliances are not to be used to supply make-up air for the ventilation systems unless their capacity is enough to serve both functions at the same time.

Sound ratings

Wall and ceiling fans that are controlled automatically or meant to operate continuously must be rated by the manufacturer not to exceed a sound level of 60 dBA or 2.5 Sones.

Exhaust Ducts

Exhaust ducts must vent directly to the outdoors. Where the exhaust duct passes through or adjacent to unheated spaces, it must be insulated to prevent moisture condensation in the duct.

Ventilation ducts must be metal, but exhaust ducts that serve only a bathroom or powder room can be made of combustible material that is impervious to water.

Service Access

Ventilation equipment must be accessible for inspection, maintenance, repair and cleaning. Kitchen exhaust ducts must be designed and installed so that the duct can be cleaned if there is no filter at the intake. Kitchen ducts must be metal.

Outdoor air intake and exhaust outlets must be shielded from weather and insects. Screening for insects may be by an accessible filter at the equipment and by a 6mm mesh screen at the intake or exhaust hood. Screening must be made of rust-proof material.

Distribution

To ensure distribution of air through the house, interior doors should be undercut ½", the rooms provided with a grille, or a transfer grill with an equivalent area.

Fan ratings must be rated by the manufacturer at a pressure difference of at least 50 Pascals.

INFORMATION WANTED

A study to evaluate the impact of the draft CSA F326 Standard for Residential Mechanical Ventilation is being done by Allen Associates. (What are the consequences for the building industry if the standard becomes mandatory?)

The study will include a review of available equipment and costs of complete systems.

If you can help, please send your literature to:

Allen Associates
33 Madison Avenue
Toronto, Ontario
M5R 2S2

Attn: Mario Kani, P. Eng.

Allen Associates would like to receive current product literature, preferably with price lists, from manufacturers and suppliers of residential ventilation equipment such as:

* exhaust fans
* make-up air fans and ducts
* recirculation fan systems
* central exhaust systems
* heat recovery ventilators
* exhaust air heat pumps
* passive supply vents
* forced air and low flow high-wall or ceiling supply registers
* exhaust grilles
* intake and exhaust vent hoods (for exterior walls, complete with screens add/or filters)
* ductwork (with an without insulation an for low-flow applications)
* and controls.

Information required is engineering and technical in nature and should specify, among other data, air flows, sound ratings, and applicability.

FIREPLACE DAMPERS: Do They Really Work?

Richard Kadulski

It is common knowledge that fireplaces are leaky, inefficient, and backdraft easily. We also know that fireplace dampers don't do a good job. But just how bad (or how good) are fireplace dampers?

It seems that until recently no one had taken a serious, scientific look at this. Results of a study done by Sheltair Scientific Ltd. sheds some interesting and disturbing information on this issue - one that should be considered carefully by all builders, designers and regulatory authorities.

What was the study?

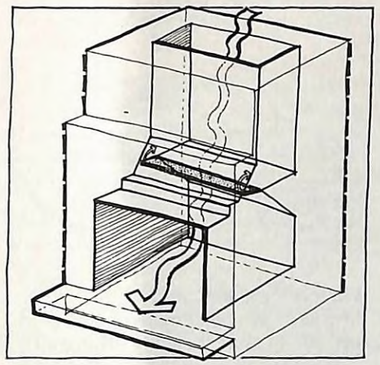
Air leakage tests were conducted to determine the leakage area around chimney dampers when closed.

A portable flow chamber was used to measure flow through the fireplace at a standard pressure difference of 10 Pascals. 15 typical fireplaces were tested. *The average chimney leakage area with the damper closed was 91 cm^2 (14 sq. in).*

A range of ages and sizes of fireplaces were included in the study: twelve were site-built masonry units, one was a zero-clearance fireplace, and two were combined masonry and prefabricated metal.

How much air movement is there?

Three Vancouver area houses were chosen for detailed monitoring of air flows through the fireplaces. All three were single-family, gas-heated houses with full basements. Two were 2 storeys, with a fireplace located on the west side wall of the main floor with an exposed exterior masonry. The third was a single storey house with a centrally located fireplace, and a single chimney supporting both the fireplace flue and the furnace flue. All these fireplaces were connected to uninsulated, clay-lined masonry chimneys. The fireplaces were open wood burning masonry units and appeared to have been well used.



Each test collected detailed information for periods of 24 hours. Testing was done to establish a typical range of air flows under varied weather conditions.

It is commonly thought that the greater the temperature difference, the greater the airflow. However, *measurements showed that air flows through exterior masonry fireplace chimneys are relatively insensitive to indoor/outdoor temperature changes.* At a temperature difference of 6°C, backdrafting is occurring at about 3.5 l/s (7 cfm). As the temperature difference increases to 18°C, (i.e. the colder the weather) the flow direction changes, but the absolute flow quantities remain the same.

The poor thermal design of a masonry chimney means that the small amount of warm *air leakage provides little buoyancy or stack pressure.* The cool chimney essentially operates like a pipe stuck horizontally out of the house. The flows are primarily influenced by house stack pressures and wind-induced pressures on the open end of the chimney "pipe."

The amount of air flow through fireplace chimneys (with no fire) is mainly a function of the size of the leakage area around the damper and the strength of the winds at the chimney top. Absolute chimney flows do not increase significantly with indoor/outdoor temperature changes.

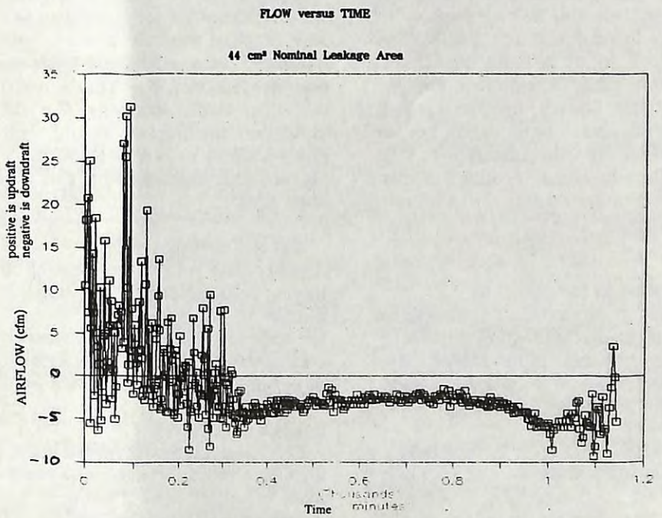


Figure 1

In gusty weather the flow direction and quantities in the chimneys was observed to be very erratic. Regular flip-flops in direction are common, changing as often as every half hour. While up flows are more frequent, the down flows are about twice as powerful, presumably due to the additional pull from house stack pressures.

Figure 1 shows airflow in a flue over a 1 day period. Downdrafting became a stable condition after winds calmed down during the night.

Chimney flows for the same house during strong winds maintained an updraft despite a slight house depressurization (about 2 Pascals) during the first 10 hours of monitoring. As the indoor/outdoor pressures reach a neutral level, average chimney flows increase, average, from 5 L/s to 9 L/s. (10 cfm to 18 cfm).

It was discovered that under stable conditions there was a steady airflow **down** the flue. The average flows varied from 2.6 to 7.7 l/s (5 to 15 cfm).

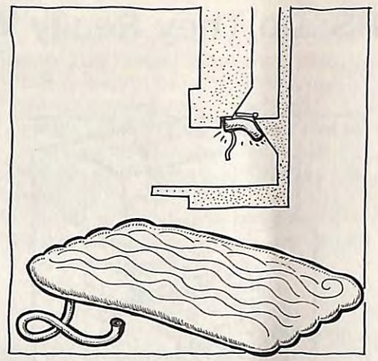
Computer simulation found that long-term air flow rates through a cold fireplace chimney are determined by the amount of air leakage area around the damper and the average wind speed across the chimney top. Flows remain fairly constant over the heating season, reflecting average wind speeds across the chimney top. Whether the air flows are up or down the chimney, they represent an equivalent energy cost to the householder and a potential pollution source to the home interior.

Colder outdoor temperatures will increase the cost of heating but may not increase air losses through the chimney.

The Reason for the Study

This study was done to provide an independent, thorough evaluation of the effectiveness of the DAVIC Heat Barrier as an air sealing application and as an energy conserving device for fireplace dampers.

The DAVIC Heat Barrier (patented in Canada and the United States) is a new approach to sealing fireplace chimneys. The device is easy to use, affordable, aesthetically neutral (i.e. you can't see it when it's in use), and



suitable for almost all types of fireplaces. No other existing device appears to meet these key criteria.

How does it work?

It is an air inflatable (by lung-power) pillow for insertion into the fireplace below the damper. It looks like a mini air mattress. The purpose is to eliminate (or reduce to nominal levels) the air flow through fireplace flues when not in use.

The heat barrier is designed with the homeowner in mind, as installation is simple: by just inflating and placing it into the cold fireplace.

It may sound like a messy operation, but it is not meant for those who use their fireplace regularly. Most people use their fireplace only 3 or 4 time per year: at Christmas, Ney Year's, and 1 or 2 other special occasions. The rest of the time the fireplace is cold. This product offers an alternative to the plywood plug in the opening that is often used.

The principal reason for sealing fireplace flues is to reduce heating and cooling costs. Secondary advantages include the elimination of uncomfortable drafts in the immediate area of the fireplace and the reduction of noxious gases and particles drawn into the building when air enters through the chimney.

Downdrafting from fireplaces is a growing problem, because it is more likely to happen when a house is depressurized. This is happening as a result of tighter building envelopes and increased exhaust capacity in houses.

Does this product work?

For houses in areas with moderate wind speeds, installation of a DAVIC Heat Barrier is expected to reduce air flow by about 8 l/s. In high wind areas, the reduction in air flow attributable to a DAVIC Heat Barrier will be in the range of 15.5 l/s.

Where the DAVIC Heat Barrier was properly fitted into a fireplace, its affect was to reduce the leakage area on average by 64 %.

How much will this product save?

Estimated energy savings vary considerably with climate, average wind speeds, and the price of energy. Savings are estimated to range from $16 to $90 per year for the majority of houses in Canada and the Northern United States. The price of each is expected to be around $20.00 (at the local hardware store).

The Importance of the study

This study was done to evaluate and provide material that can be used to help market an energy conservation product. However, *it also pointed out that constant downdrafting of fireplace flues is not a rare situation*. If the fireplace has never been used, and the flue is perfectly clean, the incoming air can be tolerated even though it may cause discomfort. But once the fireplace has been used once, the flue is lined with combustion by-products that condense on the flue. How safe it is to bring those gasses back into the house? Worse, what about the backdrafting of smouldering gasses back into the house as the fire dies down (when the draft is weakest)?

The Davic Heat Barrier Evaluation was prepared for Davic Enterprises Inc. by Sheltair Scientific Ltd. of Vancouver.

MARKETING:
Developing and Nurturing a Corporate Image

Conventions often are attended for social reasons: to meet and renew acquaintances with colleagues, or for business (to establish contacts and line up future work).

Scheduled technical sessions often are not well attended, but these may be worth much more than the price of the convention! The 1988 annual convention of CHBA-BC in Victoria B.C. provided just such an opportunity. The highlight of the convention (which did manage to attract a full house) was a marketing session conducted by Peter Halter a real estate marketing specialist from Atlanta, Georgia.

The small contractor who builds 6 or 8 houses per year will not follow a marketing campaign in the same fashion as the large builder promoting a 100 unit development, but elements of his presentation apply to all builders. Professionals and suppliers can also benefit from some of the points made. (Peter Halter is scheduled to speak at the CHBA National convention in Hamilton, Ont., Feb. 5-8, 1989).

The corporate image

What is it? It's the face you present to the public: prospective customers, suppliers, and the community at large. Whether we like it or not, first impressions are often as important as the later follow up.

How is it developed?

The image you project should be well thought out. The first thing to do is sit down and develop or rethink your business plans. This is best done in discussion with several people (e.g. your wife, business partner, accountant, or close friends). Questions you must ask yourself include:

* *Who am I?*
* *What do I want to be?*
* *What is my goal in business?*
* *Who do consumers think I am?*
* *Who do associates think I am?*
* *What is my mission statement? (e.g. "the best name in business", or "quality craftsmanship").*

By thinking about these questions you can define what points about your business and activities you want to emphasize. It will provide you with a better idea of how to create a corporate image for your company that will generate benefits over time.

You must be frank in rating your strong and weak points. All small business owners are under pressure. Small builders especially are under stress to be chief cook and bottle washer as well as janitor and salesman. By careful analysis you may be able to decide which jobs you can undertake comfortably, and which ones are best handled by someone else (even if you have to hire someone on a contract basis).

The best marketing for you is done by your customers - those to whom you sell your products or services.

Creating the Image

A reputation is not created overnight. It is part of a long term process that must be earned. The most cost effective image creation comes from a commitment to excellence: to employees and customers alike.

Just think about the companies you do business with - which ones are you happy dealing with? Which ones do you avoid? Chances these are the ones that don't take pride in their efforts, will have dissatisfied employees and a high customer turnover.

A successful image is not only built by attention to your own activities, but also with community and industry involvement. Your company should participate in the community, be it support to local sports groups, the United Way, church or cultural organizations. But do so in a thoughtful manner - don't just send a few small cheques to a variety of causes. Make a meaningful contribution (it could even be the offer of your services to a project for free or a nominal fee).

A healthy bottom line will be much more so over a longer time if your customers have confidence in you and feel good about doing business with you. Those that are perceived to be out there for the fast buck, not caring about anyone else, even if they are technically competent, will not generate the same rewards.

In your dealings with the press, customers, and the community at large, be consistent. If there are several people in your organization, one should be the designated company spokesmen.

Public relation firms offer services to get your message out and to help with marketing. Large corporations and governments make use of them regularly, but Peter pointed out that for small companies PR consultants can be a waste of money! Your company's actions speak more loudly than any high priced hired gun can. Consistency of deeds and words must be maintained.

You must remember that success is not accomplished by plans but by people.

Projecting a consistent image

An image once developed must be carried through: all communication pieces you have should follow the standard you set. Business cards, letterheads, brochures, signs, etc. must be considered, and should be consistent. Think about what the large corporations do; look at the material that they put out. There is a standard format for use of the logo, name, and product description on all their advertising, product literature and

A quality look can be achieved using simple techniques - you don't need to spend fortunes for 4 colour, gold embossed mailers, cards, brochures or site signs. Simple, crisp and clean graphics can be just as effective.

Peter stressed the value of first impressions. He pointed out that they have found it pays to spend extra effort on the design and production of an image and brochure covers for marketing projects. The interior contents can then be done in a cheaper, more basic manner. The brochure or folder cover itself can set the overall tone for the project.

Getting your message out

They have found that a lot of print advertising is not always justified as it does not always translate into sales. In the long run, your image and referrals are the most valuable business generators.

The best marketing for you is done by your customers - those to whom you sell your products or services. Some of the ideas Peter Halter's company uses can easily be adopted by the smallest of builders. They offer a strategy for long term follow up.

Follow-up

On the anniversary of purchase (or moving-in) a housewarming card is sent to the homeowner. During the week between Christmas and New Year's a card is sent wishing the homeowner a happy and prosperous New Year. In the third year, the homeowner is sent advance mailing of new project openings or open houses.

One idea for follow-up service to keep your customers happy is to write into the contract a "warranty fund". The homeowner is provided with the standard first year warranty and follow up service. The purchaser is also informed that you've budgeted $500 for this work. As calls are made and service work done, the owner is sent a statement showing how much the call cost. Each warranty call is deducted from the warranty fund. At the end of the warranty period unused funds are returned to the homeowner. (Presumably, it should never be necessary to go over the limit).

Another successful idea is the preparation of a video "owner's manual" which is given to the homeowner at the time the deal is closed or the homeowner is moving in. It shows key elements in the care of important plumbing, heating and ventilating equipment and appliances. Other than the cost of a video camera, you need only walk though the house showing equipment and what needs to be done to it to keep it in running order. Equipment suppliers may be willing to supply portions for their products.

Referrals

Referrals are the best overall way to get customers. If you keep your past customers happy, and your name in their consciousness (by the occasional card) they can generate profitable leads. So can realtors, bankers and others.

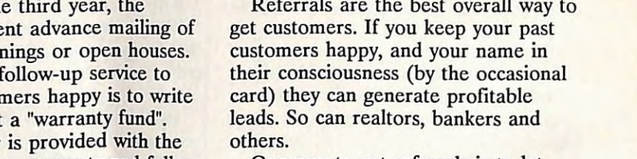
One way to get referrals is to let people know that you will reward them for successful referrals. It could be an evening out at a fancy restaurant, a basket of fruit, or some other appropriate gift. Remember that referral generated sales are strictly driven by performance. If there is no sale, there is no cost to it.

I've tried to highlight a few of the points presented in an all too brief 2½ hour presentation.

The important thing to stress is that you must always put forward the best foot forward in your business dealings. If you create a consistent, strong image, it will generate a good solid reputation for your business which can only generate positive long term benefits. Always keep in mind that you must look at the long term as well as the immediate future.

Richard Kadulski

ENERGY EFFICIENT LAMPS

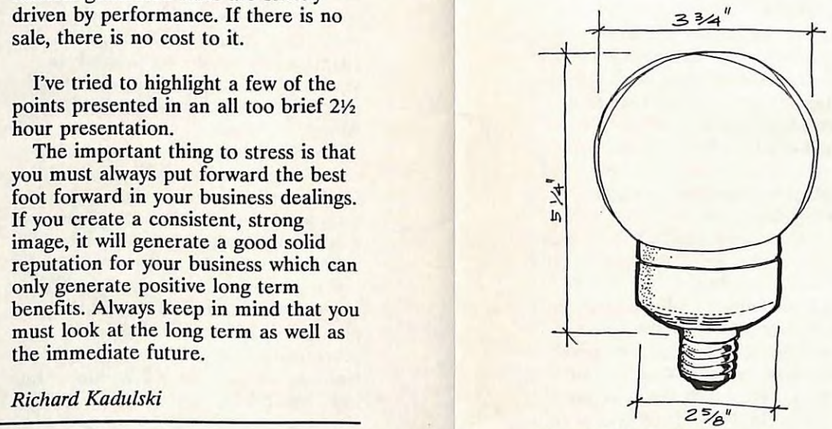


Philips SL & PL series

Lighting is something most of us take for granted. We rely on light fixtures to enable us to perform tasks easily, move about safely, play games or read. When there is not enough daylight, we turn on the light switch. We usually think of incandescent light bulbs to provide the lighting.

There are other light sources available today which are not as well known. Compact fluorescent lamps are just beginning to make a major penetration in the market. Not all have the same light properties as the incandescent lamps we are used to. Some are decidedly "cool" tones. However, where appropriate, there is no reason why they should not be taken advantage of.

Compact fluorescent lamps combine the high efficiency and the long life of the fluorescent tubes commonly used in commercial applications but in a compact shape that allow them to replace incandescent bulbs in many existing fixtures. To do this, an adapter which contains the ballast and can be screwed into an incandescent socket is used. Some units utilize separate fluorescent tubes and adapters, others combine the tube and adapter into a single unit.



Mitsubishi MARATHON BULB

Toshiba NEO-BALL

Compact fluorescent lamps have either two or four small tubes. Connected at one end, Quad-tubes are two bi-tubes connected to one base. Quad-tubes were developed because the bi-tube or twin-tube was too long for some applications. With the two bi-tubes the lamp output was increased while the length of the unit was decreased, giving more replacement flexibility. The Philips PL series lamps are mini-tubes.

Some lamps also have a covering over the tube so they look similar to the regular incandescent bulb. These are similar in size to large incandescent bulbs. A drawback to their wide spread use is that not all lamp fixtures can accommodate many of these new lamps. Some, such as the Toshiba and Mitsubishi (Fig. 2) are very similar in appearance and size of "fat albert" lamps. If they fit the housing, they can be used for pot lamps. However, as with any fluorescent, they cannot be used with standard dimmer switches.

Colour Rendering

Our perception of our surroundings is affected by the colour of the light source they are viewed under. That is why one colour will have a different appearance when viewed under sunlight or artificial lighting.

The way a fluorescent light source renders colours depends on the type of coating used on the inside of the tube. The coatings used on compact fluorescent lamps give a range of colour rendering. Some units are similar to incandescent bulbs.

Efficiency

We have gotten used to look at lamps in terms of their power rating (i.e. 60 watt or 100 watt bulb) and equate it to the light output. Lamp efficiency is determined by how much light is produced in relation to the amount of energy used. However, the amount of light produced is measured in *lumens*. The wattage is merely a rating of the amount of power consumed by the lamp.The greater the number of lumens produced per watt, the greater the efficiency. By using more efficient light sources, the consumption of energy can be decreased while maintaining comparable levels of light.

Compact fluorescent lamps produce 4 -5 times as many lumens per watt as do incandescent lamps. Their energy saving potential is thus very large. Table A gives a comparison of light output between incandescent and fluorescent lamps.

Florescent lamps have a much longer life than incandescent lamps. Compact fluorescent lamps are rated at up to 10,000 hours of operation, based on three hours of operation per use, compared to 750 to 1,000 hours for most incandescent lamps.

Where fluorescents are used 24 hours a day, such as for lighting apartment halls, the length of life can increase to about 15,000 hours or (two years).

Compact fluorescent lamps consume less electricity while giving comparable lighting, reducing the cost of operation.

Compact fluorescent lamps should be of special interest for use in areas which require long or continuous lighting, and where electrical costs are high (but they shouldn't be used outdoors in extreme climates).

How much? Because the lamps must have a ballast, they are expensive - the retail price is about $16-20.00 per unit. The units with re-useable ballast (such as the Phillips PL lamps) are cheaper.

Not all units have CSA approval, so they are not readily available everywhere. However, they can be used if approved by local electrical authorities. (B.C. Hydro undertook a field trial with a number of lamps - by

TABLE A: Incandescent Vs. Compact Fluorescent Lamps

Incandescent		Compact Fluorescent Lamps		
			Total Watts	
Watts	Lumens Per Watt	Watts	Including Ballast	Lumens Per Watt
25	10.8	5	6	50
40	12.8	7	8	57
60	14.3	9	10	67
75	10.8	13	16	69
100	16.3	18	26	69

obtaining special use permission from the B.C. Electrical inspection authority).

Suppliers

These lamps are new, and not all have CSA approval (some manufacturers are not certain if it's worth their while to try to undergo the expense). Several lighting fixtures are now being made that will accommodate compact fluorescent lamps. Some are for commercial other for residential applications.

The following is a list of the lamps (and their manufacturer) that we have seen. For technical details such as light output, price, and availability check with your local electrical supplier.

General Electric
CIRCLITE (a circular tube that looks like a small spaceship)
COMPAX (a large globe)

Mitsubishi
MARATHON BULB

Osram
DULUX

Philips
SL & PL series of lamps. These have reusable ballasts

Toshiba
NEO-BALL (a large globe)

Other manufacturers with compact fluorescent lamps are Daycoa, East Rock Technologies, Energy Reduction Systems, GTE/Sylvania, Interelectric Lighting Products, Lumatech, Panasonic. We are not certain how many of these are available in Canada.

ODDS 'N ENDS

1989 RESIDENTIAL VENTILATION TRAINING Courses

Residential Mechanical Ventilation Design and Installation courses are scheduled for early 1989.

Only one residential ventilation course based on the Preliminary CSA Standard F326 "Residential Mechanical Ventilation Requirements" is being offered this year by HRAI. The draft standard will be adopted by the R-2000 program in early 1989. It is also anticipated that the standard will be adopted by the National Building Code and other regulatory codes in the near future.

The two day course (fee $250.00) is aimed at those responsible for the design, installation and inspection of ventilation systems. This course is appropriate for all persons involved in the residential construction.

Those who successfully complete the course will be certified as an HRAI Residential Mechanical Ventilation Installer. This certificate will replace all previous HRV Installer Certificates.

There will not be an Installers Update course this year. All installers must take this course to be certified or recertified.

To register or for information call (toll free) 1-800-268-2703.

Yellowknife	Mar. 1 -2
Whitehorse	Feb. 27-28, Mar. 15-16
Kelowna	Jan. 23-24
Prince George	Mar. 1-2
Vancouver	Feb. 8-9, Feb. 13-14, Mar. 6-7
Victoria	Feb. 20-21
Calgary	Feb. 21-21
Edmonton	Feb. 6-7
Saskatoon	Feb. 6-7
Brandon	Mar. 13-14
Winnipeg	Jan. 23-24, Feb. 15-16, Feb. 20-21, Mar. 8-9
Bracebridge	Feb. 1-2
Kingston	Jan. 25-26
London	Feb. 15-16, Mar. 8-9
Ottawa	Feb. 13-14, Mar. 1-2
Sudbury	Feb. 8-9
Toronto	Jan. 30-31, Feb. 20-21, Feb. 27-28, Mar. 6-7, Mar. 20-21
Fredericton	Feb. 1-2
Moncton	Feb. 13-14, Mar. 20-21
Saint John, NB	Feb. 22-23
Halifax	Jan 30-31, Feb. 1-2, Feb. 22-23, Feb. 27-27, Mar. 8-9
Sydney, NS	Jan. 23-24, Mar. 13-14
Charlottetown	Mar. 15-16
St. John's NF	Mar. 1-2

Radon: (another update)

So you thought you heard the last about radon? A brief item in the current issue of *Scientific American* quotes several radiation experts that dispute the US-EPA action level for radon mitigation.

One of the key assumptions with the whole radon issue is that risk is proportional to the dose of low level radiation exposure. This is being challenged by a physicist at the University of Pittsburgh. Looking at 411 counties across the US he found that lung cancer mortality is lower where radon exposure is high - the opposite of what might be expected. He suggests that an explanation may be in the notion that low doses of radiation might actually protect against cancer!

There could be something to this argument, on the other hand there could be some other as yet unknown explanation.

The only certain thing is that as radon is a naturally found material, it is not a case of a company covering up a mess it has created.

Perhaps the **Sunshine Radon Health Mine** in Montana may be onto something. It's a spa that is located on the site of an old uranium mine. They *"do not guarantee any cures, but if one reads the testimonials in the mine, it is evident that many receive benefits from breathing the radon gas"*. Their brochure suggests relief or recovery from *"arthritis, asthma, emphysema, diabetes, eye problems and sinus or allergy problems"*. The recommended dose is a 1-1/2 hours visit 3 times per day (at $2.50 per visit).

This isn't a joke - there really is such a place!

Low-E glass

Andersen, the largest window manufacturer in the USA reports that almost two thirds of all product orders are calling for low-e glass. They first introduced low-e glass in 1983.

The speed with which the market has accepted low-e suggests that regular double glazing is going to become obsolete soon.

Drywall Discoloration

There have been a rash of incidents of drywall staining across the country. It was first thought it might be mould growth from poor ventilation or some similar cause. However, the problem has happened in all kinds of houses in all parts of the country.

Lab-testing is going on at NRC's Institute for Research in Construction to determine the nature of the problem. Preliminary evidence points to a problem with the drywall joint compound as the cause the staining. CHBA's Technical Research Committee has heard that a more thorough (and expensive) research program may be required to get to the bottom of this.

Until the cause of the problem and its solution is known, builders who have experienced this problem should consider the following measures:

1) Use a good quality alkyd primer-sealer prior to stippling or finish painting.

2) Decrease indoor moisture levels and try to ensure that houses can dry out quickly between coats of joint compound and paint.

3) To repair an existing problem, it appears that repainting with a good quality alkyd paint may work.

There is no guarantee that these measures will avoid or repair the problem. We will keep you posted as more information becomes available.

Preserved Wood Foundations: you have to build them correctly

Last year the river in Slave Lake, Alberta broke its banks and flooded parts of the town. Five houses sustained major damage when raging waters moved through two sub-divisions. Four of these homes had preserved wood foundations.

The preserved wood foundation has had its critics over the years. The flood added fuel to the argument they should not be incorporated into homes in low-lying subdivisions. The concrete industry is quick to take advantage of the situation to press the benefits of concrete.

An engineering review to analyze the flood created problem pointed out that *the foundations did not fail because they were made of wood, but as a result of incorrect construction practices*.

Of the buildings that failed there is no evidence they were designed or inspected by a professional engineer. In Alberta, the code requires that wood foundations be designed and inspected by engineers. It is up to the owner or builder to ensure the code is followed. The owner is required to request an inspection at certain phases of construction. Such inspections are often avoided in part because they are perceived simply as an additional and unnecessary cost.

The temptation to take short cuts is always there, and it is sometimes difficult to safeguard against builders cutting corners. The Slave Lake situation has shown the risks are great. Be warned!

Careful attention to design specifications and details is important - not just to satisfy the ego of the designer, but also for sound structural reasons.

February 13-18, 1989: Congress and Exhibition on Housing for Cold Climate, St. Paul, Minnesota. An event to advance the housing industry in comfort, energy-efficiency, health, durability, and affordability of housing for cold climate areas. For information:
Minnesota Energy Council,
P.O. Box 76070, St. Paul, MN 55175
Tel 612-378-2973

RENEWABLES: a clean energy solution

1989 LEBCO SYMPOSIUM
June 19-21, 1989

Environmentally appropriate building is not only defined by sound building science, energy efficiency and improved ventilation, but also it must be judged by its conduciveness to health and well-being and kind to the environment.

While this may sound like a motherhood issue, there are serious technical implications. The design of a home for a chemically sensitive person may be an extreme case - but it does point to a problem that exists now. If we are serious about a concern to get back into harmony with nature and to clean up our environment we must look at all these concerns.

These are some of the topics that will be discussed at the conference. Next issue we will provide more information and a preliminary program.

Technical papers on energy conservation and renewable energy research and development are being solicited. The deadline is soon - so call today!

Wether or not you plan to write a paper, mark your calendar and plan to attend. For details:

Solar Energy Society of Canada
3 - 15 York Ottawa, Ont. K1N 5S7
Tel: (6130 236-4594

EXCELLENCE IN HOUSING '89

WINNIPEG, MANITOBA - CANADA
MARCH 2-4, 1989

SEVENTH ANNUAL INTERNATIONAL
ENERGY EFFICIENT BUILDING
CONFERENCE AND EXPOSITION

Presented By:

EEBA Energy Efficient Building Association

in cooperation with:
Energy, Mines and Resources - Canada
Manitoba Home Builders Association
Manitoba Energy and Mines
University of Southern Maine

Registration Details:
Manitoba Home Builders Association
Attn.: Don Glays, Exec. Officer
239-1120 Grant Ave.
Winnipeg, Manitoba R3M 2A6, Canada
(204) 477-5110, (FAX) 204-477-5139

GENERAL CONFERENCE
MARCH 3 & 4 1989
HEALTH & SAFETY ISSUES
VENTILATION AND MOISTURE CONTROL
AFFORDABLE HOUSING INITIATIVES
RETROFIT APPLICATIONS
INTEGRATED MECHANICAL SYSTEMS
HEATING SYSTEMS

PRE-CONFERENCE WORKSHOP
MARCH 2, 1989
R-2000 BUILDERS WORKSHOP
MARKETING STRATEGIES
VENTILATION SYSTEMS
RADON MITIGATION TECHNIQUES
HOUSING FOR NORTHERN AND
REMOTE COMMUNITIES

SUBSCRIBE TODAY!

SOLPLAN REVIEW is an independent Canadian newsletter published 6 times per year to provide news, technical details, new product information, insights and commentary on developments covering all aspects of building science and energy efficient building practice for new and retrofit residential construction.
SOLPLAN REVIEW serves the needs of professional and interested lay persons. Technical information is presented in a clear, concise manner, without resorting to jargon.

YES, I WANT TO SUBSCRIBE TO SOLPLAN REVIEW

ONLY $ 30.00 per year
(u.s.a. and other foreign pay in u.s. funds).

payment enclosed please bill us P.O. # _____

please charge to credit card:
VISA MASTERCARD AMERICAN EXPRESS

card number: _____ expiry date: _____

signature: _____

name: _____

address: _____

_____ post code: _____

the drawing-room graphic services ltd.
box 86627 north vancouver b.c. V7L 4L2